REMARKS

Claims 1-16 are pending in this application. By this Amendment, Applicant AMENDS claims 1, 5 and 7.

The Examiner rejected claims 1, 2, 5-10, 12, 13, 15 and 16 under 35 U.S.C. § 102(a) as being anticipated by, or in the alternative, under 35 U.S.C. §103(a) as being obvious over Kaida (US 6,040,652), Kaida et al. (US 6,232,698), Ogawa (US 4,894,580) or Kittaka et al. (US 4,939,403). The Examiner rejected claims 3, 4, 11 and 14 under 35 U.S.C. § 102(a) as being anticipated by or in the alternative, under 35 U.S.C. § 103(a) as being obvious over Kittaka et al. It should be noted that Kaida et al. (US 6,232,698) has been incorrectly indicated as a 35 U.S.C. §102(a) reference because the publication date of Kaida et al. (US 6,232,698) of May 15, 2001 is after Applicant's filing date of August 26, 2000. Applicant believes that the Examiner intended to use Kaida et al. (US 6,232,698) as a 35 U.S.C. §102(e) reference. Applicant respectfully traverses the rejections of claims 1-16.

Claim 1 has been amended to recite:

"An energy-trap thickness extensional vibration mode piezoelectric resonator, comprising:

a piezoelectric body including a plurality of piezoelectric layers and uniformly polarized in a thickness direction thereof; and

N number of internal electrodes, where N equals 3, 4 or 5, arranged in the piezoelectric body on top of each other with the piezoelectric layers disposed therebetween; wherein

the piezoelectric body vibrates in an (N-1)th higher-order mode of a thickness extensional vibration mode generated by applying electric fields of opposite polarity alternately in the direction of thickness to piezoelectric layers between internal electrodes, and when the thickness of a piezoelectric layer between adjacent internal electrodes in the direction of thickness is denoted by D and the thicknesses of a first and second piezoelectric layer outside the outermost internal electrodes in the direction of thickness are denoted by D_1 and D_2, the following relationships are satisfied: **$0.50 \leq (D_1 + D_2)/2D \leq 0.90$ at N = 3 and 4, and $0.50 \leq (D_1 + D_2)/2D \leq 0.80$ at N = 5.**" (emphasis added)

Claim 3 recites:

"An energy-trap thickness extensional vibration mode piezoelectric resonator, comprising:

a piezoelectric body including a plurality of piezoelectric layers and uniformly polarized in a thickness direction thereof; and

N number of internal electrodes, where N equals 3, 4 or 5, arranged in the piezoelectric body on top of each other with the piezoelectric layers disposed therebetween; wherein

the piezoelectric body vibrates in an (N-1)th higher-order mode of a thickness extensional vibration mode generated by applying electric fields of opposite polarity alternately in the direction of thickness to piezoelectric layers between internal electrodes, and when the thickness of a piezoelectric layer between adjacent internal electrodes in the direction of thickness is denoted by D and the thicknesses of a first and second piezoelectric layer outside the outermost internal electrodes in the direction of thickness are denoted by D_1 and D_2, the following relationships are satisfied: **$0.10 \leq (D_1 + D_2)/2D \leq 0.80$ at $N = 3$, $0.10 \leq (D_1 + D_2)/2D \leq 0.50$ at $N = 4$, and $0.10 \leq (D_1 + D_2)/2D \leq 0.45$ at $N = 5$.**" (emphasis added)

Claim 5 has been amended to recite:

"An energy-trap thickness extensional vibration mode piezoelectric resonator, the piezoelectric resonator comprising:

a piezoelectric body including a plurality of piezoelectric layers; and

N number of internal electrodes, wherein N equals 3, 4 or 5, disposed in the piezoelectric body and stacked on each other with the piezoelectric layers disposed therebetween; wherein

the piezoelectric body vibrates in an (N-1)th higher-order mode of a thickness extensional vibration mode and piezoelectric layers located between the internal electrodes are polarized in opposite direction alternately in the direction of thickness, and when the thickness of a piezoelectric layer between adjacent internal electrodes in the direction of thickness is denoted by D and the thicknesses of a first and second piezoelectric layer outside the outermost internal electrodes in the direction of thickness are denoted by D_1 and D_2, the following relationships are satisfied: **$0.60 \leq (D_1 + D_2)/2D \leq 0.90$ at $N = 3$, $0.65 \leq (D_1 + D_2)/2D \leq 0.90$ at $N = 4$, and $0.60 \leq (D_1 + D_2)/2D \leq 0.80$ at $N = 5$.**" (emphasis added)

Claim 7 has been amended to recite:

"An energy-trap thickness extensional vibration mode piezoelectric resonator, comprising:

a piezoelectric body including a plurality of piezoelectric layers; and

N number of internal electrodes, wherein N equals 3, 4 or 5, disposed in the piezoelectric body and stacked on each other with the piezoelectric layers disposed therebetween; wherein

the piezoelectric body vibrates in an (N-1)th higher-order mode of a thickness extensional vibration mode and piezoelectric layers located between the internal electrodes are polarized in opposite direction alternately in the direction of thickness, and when the thickness of a piezoelectric layer between adjacent internal electrodes in the direction of thickness is denoted by D and the thicknesses of a first and second piezoelectric layer outside the outermost internal electrodes in the direction of thickness are denoted by D_1 and D_2, the following relationships are satisfied: **$0.10 \leq (D_1 + D_2)/2D \leq 0.90$ at $N = 3$, $0.10 \leq (D_1 + D_2)/2D \leq 0.90$ at $N = 4$, and $0.10 \leq (D_1 + D_2)/2D \leq 0.80$ at $N = 5$**." (emphasis added)

Applicant's claims recite the similar feature that the ratio of $(D_1 + D_2)/2D$ falls within a specific range. First, the Examiner has alleged that Applicant's claims 1, 3, 5, and 7 are anticipated by Kaida (US 6,040,652), Kaida et al. (US 6,232,698), Ogawa (US 4,894,580) or Kittaka et al. (US 4,939,403) because the claimed ranges of the ratio $(D_1 + D_2)/2D$ fall within the manufacturing tolerances of the resonator devices shown in Kaida (US 6,040,652), Kaida et al. (US 6,232,698), Ogawa (US 4,894,580) and Kittaka et al. (US 4,939,403).

Independent claims 1, 3, 5 and 7 all recite ranges that clearly exclude any possible manufacturing tolerances in the devices of the prior art references relied upon by the Examiner. For example, in Claims 1, 5 and 7, the maximum allowable value for the ratio claimed is 0.90, which clearly would exclude any manufacturing tolerances in the prior art devices. Furthermore, in Claim 3, the maximum allowable value for the ratio claimed is 0.80, which certainly excludes any manufacturing tolerances in the prior art devices.

Accordingly, Applicant respectfully requests reconsideration and withdrawal of the rejections of claims 1-16 under 35 U.S.C. §102(a) as being anticipated by Kaida (US 6,040,652), Kaida et al. (US 6,232,698), Ogawa (US 4,894,580), or Kittaka et al. (US 4,939,403).

Next, the Examiner has alleged that "any variations in ratio would seem to be nothing more than optimizing a known structure" in the last paragraph of page 2 of the Office Action.

However, there is absolutely no disclosure or suggestion whatsoever in any of the prior art references relied upon by the Examiner of the importance of a ratio or relationship between four variables including: (1) a thickness of a piezoelectric layer between adjacent internal electrodes in the direction of thickness; (2) a thickness of a first piezoelectric layer outside the outermost internal electrodes in the direction of thickness; (3) a thickness of a second piezoelectric layer outside the outermost internal electrodes in the direction of thickness; and (4) the number of internal electrodes.

In fact, the prior art is completely devoid of any discussion or hint that anyone recognized the importance of a relationship between the above-noted four variables, and certainly, there was no recognition of the necessity or desirability of selecting the physical characteristics of the four variables such that the specific ratios recited in Applicant's claims 1, 3, 5 and 7 are satisfied.

Furthermore, the Examiner has failed to establish that the ratio $(D_1 + D_2)/2D$ is a result-effective variable. MPEP § 2144.05 requires for a finding of obviousness that the variable be known as a result-effective variable at the time of invention. As noted above, there is nothing at all in the prior art that even remotely suggests a relationship between the four variables is important, or that the specific ratios recited in Claims 1, 3, 5 and 7 were known to be result-effective.

Ogawa (US 4,894,580) shows an energy-trap thickness extensional vibration mode piezoelectric resonator in **Figs. 1** and **3**. First, it should be noted that the piezoelectric layers outside the outermost internal electrodes are not even given a reference number (reference numbers **1** and **10** only refer to the piezoelectric member in the figures). Second, the reference only discloses that the distance **between** electrodes is a result effective variable. See **Table 1** in the forth column of Ogawa. In fact, the method of manufacturing described in lines 27-41 of column 3 implies that all

the layers, including the outermost layers are all formed with the same thickness. Ogawa clearly fails to teach or suggest that the ratio $(D_1 + D_2)/2D$ is a result effective variable. Further, Ogawa clearly fails to teach or suggest any ratio between any of the four variables recited in Applicant's claims or the specific ratios between the four variables recited in Applicant's claims 1, 3, 5, and 7.

Kittaka et al. (US 4,939,403) shows an energy-trap thickness extensional vibration mode piezoelectric resonator with piezoelectric layers outside the outermost internal electrodes only in **Figs. 9M** and **9N**. In describing **Figs. 9M** and **9N** in lines 39-47 of column 7, Kittaka et al. only teaches that it is possible to polarize the outermost piezoelectric layers, **Fig. 9N**, and that it is possible not to polarize the outermost piezoelectric layers, **Fig. 9M**. Kittaka et al. clearly fails to specifically mention the ratio $(D_1 + D_2)/2D$ and clearly fails to teach or suggest any ratio between any of the four variables recited in Applicant's claims or the specific ratios between the four variables recited in Applicant's claims 1, 3, 5, and 7.

Kaida (US 6,040,652) shows an energy-trap thickness extensional vibration mode piezoelectric resonator with piezoelectric layers outside the outermost internal electrodes only in **Figs. 8** and **9**. With respect to **Fig. 8**, the outermost piezoelectric layers are given reference numbers **22e** and **22f**, but these reference numbers are never mentioned anywhere else in the specification. With respect to **Fig. 9**, the outermost piezoelectric layers are given reference numbers **32e** and **32f**. In describing **Fig. 9** in lines 9-25 of column 9, Kaida only states that the outermost piezoelectric layers **32e** and **32f** are provided. Kaida clearly fails to specifically mention any ratio between any of the four variables recited in Applicant's claims or the specific ratios between the four variables recited in Applicant's claims 1, 3, 5, and 7.

Kaida et al. (US 6,232,698) shows an energy-trap thickness extensional vibration mode piezoelectric resonator. However, Kaida et al. clearly fails to teach or suggest a piezoelectric resonator with piezoelectric layers outside the outermost internal

electrodes or any ratio between any of the four variables recited in Applicant's claims or the specific ratios between the four variables recited in Applicant's claims 1, 3, 5, and 7.

The Examiner is reminded that prior art rejections must be based on evidence. Graham v. John Deere Co., 383 U.S. 117 (1966). The Examiner is hereby **requested to cite a reference** in support of his position that it was well known at the time of Applicant's invention that the ratio $(D_1 + D_2)/2D$ is a result effective variable. If the rejection is based on facts within the personal knowledge of the Examiner, the data should be supported as specifically as possible and the rejection must be supported by an affidavit from the Examiner, which would be subject to contradiction or explanation by affidavit of Applicant or other persons.

Next, the Examiner has alleged that the Applicant has not established unexpected results. There is nothing in the relevant case law that stands for the general proposition that an Applicant for a patent must make a showing of criticality or unexpected results unless the difference between a claimed invention and the prior art is a range of a result effective variable. In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990). Thus, there is absolutely no requirement whatsoever that Applicant establish unexpected results in this case.

What is required however is that the Examiner cite a specific prior art reference that establishes that the four variables recited in Applicant's claims were recognized as being result-effective and that the specific ratios recited in Applicant's claims were either specifically known or clearly suggested by the prior art reference(s). The Examiner has failed to cite any prior art reference that satisfies these criteria for rejecting Applicant's claims.

Even though Applicant is clearly not required to establish unexpected results in this case given the clear failure of the prior art to suggest the result-effectiveness of the variables and the ratios between the four variables as recited in the claimed invention, Applicant has described results achieved by the present invention which were not recognized or expected by those of skill in the art at the time Applicant's invention was

made. More specifically, as described in the originally filed application, by using the claimed ranges for the ratio $(D_1 + D_2)/2D$, Applicant's claimed invention **minimizes** the variation of frequencies among different resonators caused by manufacturing techniques (See for example Applicant's **Fig. 6** and the paragraph bridging pages 19 and 20 of the originally filed Specification). Furthermore, Applicant's claimed invention strongly excites the (N-1)th mode while weakly exciting the (N+1)th mode, where N = 3, 4, and 5, which can be seen in Applicant's **Figs. 25-27** and **40-42**, and which is not taught or suggested by the prior art of record.

Accordingly, Applicant respectfully requests reconsideration and withdrawal of the rejections of the claims under 35 U.S.C. §103(a) as being obvious over Kaida (US 6,040,652), Kaida et al. (US 6,232,698), Ogawa (US 4,894,580), or Kittaka et al. (US 4,939,403).

Accordingly, Applicant respectfully submits that Kaida (US 6,040,652), Kaida et al. (US 6,232,698), Ogawa (US 4,894,580), and Kittaka et al. (US 4,939,403), applied alone or in combination, fail to teach or suggest the unique combination and arrangement of elements recited in Applicant's claims 1, 3, 5, and 7 of the present application. Claims 2, 9, and 13 depending upon claim 1 are allowable for at least the reasons that claim 1 is allowable. Claims 4, 10, and 14 depending upon claim 3 are allowable for at least the reasons that claim 3 is allowable. Claims 6, 11, and 14 depending upon claim 5 are allowable for at least the reasons that claim 5 is allowable. Claims 8, 12, and 16 depending upon claim 7 are allowable for at least the reasons that claim 7 is allowable.

In view of the foregoing amendments and remarks, Applicant respectfully submits that this application is in condition for allowance. Favorable consideration and prompt allowance are solicited.

To the extent necessary, Applicant petitions the Commissioner for a One-month extension of time, extending to January 20, 2003, the period for response to the Office Action dated September 18, 2002.

The Commissioner is authorized to charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 50-1353.

Respectfully submitted,

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VERSION WITH MARKINGS SHOWING CHANGES MADE

1. An energy-trap thickness extensional vibration mode piezoelectric resonator, comprising:

a piezoelectric body including a plurality of piezoelectric layers and uniformly polarized in a thickness direction thereof; and

N number of internal electrodes, where N equals 3, 4 or 5, arranged in the piezoelectric body on top of each other with the piezoelectric layers disposed therebetween; wherein

the piezoelectric body vibrates in an (N-1)th higher-order mode of a thickness extensional vibration mode generated by applying electric fields of opposite polarity alternately in the direction of thickness to piezoelectric layers between internal electrodes, and when the thickness of a piezoelectric layer between adjacent internal electrodes in the direction of thickness is denoted by D and the thicknesses of a first and second piezoelectric layer outside the outermost internal electrodes in the direction of thickness are denoted by D_1 and D_2, the following relationships are satisfied: [$0.50 \leq (D_1 + D_2)/2D < 1.00$ at N = 3,] $0.50 \leq (D_1 + D_2)/2D \leq 0.90$ at N = 3 and 4, and $0.50 \leq (D_1 + D_2)/2D \leq 0.80$ at N = 5.

5. An energy-trap thickness extensional vibration mode piezoelectric resonator, the piezoelectric resonator comprising:

a piezoelectric body including a plurality of piezoelectric layers; and

N number of internal electrodes, wherein N equals 3, 4 or 5, disposed in the piezoelectric body and stacked on each other with the piezoelectric layers disposed therebetween; wherein

the piezoelectric body vibrates in an (N-1)th higher-order mode of a thickness extensional vibration mode and piezoelectric layers located between the internal electrodes are polarized in opposite direction alternately in the direction of thickness,

and when the thickness of a piezoelectric layer between adjacent internal electrodes in the direction of thickness is denoted by D and the thicknesses of a first and second piezoelectric layer outside the outermost internal electrodes in the direction of thickness are denoted by D_1 and D_2, the following relationships are satisfied: $0.60 \leq (D_1 + D_2)/2D$ $\underline{\leq 0.90}$ [< 1.00 or $1.00 < (D_1 + D_2)/2D \leq 1.10$] at N = 3, $0.65 \leq (D_1 + D_2)/2D \leq 0.90$ at N = 4, and $0.60 \leq (D_1 + D_2)/2D \leq 0.80$ at N = 5.

7. An energy-trap thickness extensional vibration mode piezoelectric resonator, comprising:

a piezoelectric body including a plurality of piezoelectric layers; and

N number of internal electrodes, wherein N equals 3, 4 or 5, disposed in the piezoelectric body and stacked on each other with the piezoelectric layers disposed therebetween; wherein

the piezoelectric body vibrates in an (N-1)th higher-order mode of a thickness extensional vibration mode and piezoelectric layers located between the internal electrodes are polarized in opposite direction alternately in the direction of thickness, and when the thickness of a piezoelectric layer between adjacent internal electrodes in the direction of thickness is denoted by D and the thicknesses of a first and second piezoelectric layer outside the outermost internal electrodes in the direction of thickness are denoted by D_1 and D_2, the following relationships are satisfied: $0.10 \leq (D_1 + D_2)/2D$ $\underline{\leq 0.90}$ [< 1.00 or $1.00 < (D_1 + D_2)/2D \leq 1.10$] at N = 3, $0.10 \leq (D_1 + D_2)/2D \leq 0.90$ at N = 4, and $0.10 \leq (D_1 + D_2)/2D \leq 0.80$ at N = 5.